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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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REFLECTIVITY, INC.
350 POTRERO AVENUE
SUNNYVALE, CA 94085

EXAMINER
CHEN, ERIC BRICE

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 12/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/766,776	Applicant(s) DOAN, JONATHAN
	Examiner Eric B. Chen	Art Unit 1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 January 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final..

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-116* is/are pending in the application.

4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) *1,2,5,9,10,13,14,17-21,26,27,29-31,33-40,42-50,52-58,60-70,72-78,80-99,101-112, and 114-116* is/are rejected.

7)☒ Claim(s) *3,4,6-8,11-15,16,22-25,28,31,32,41,51,52,59,67,71,79,93,100,and 113* is/are objected to.

8)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ______ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *1/27/04; 4/27/05*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ______ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: ______.

DETAILED ACTION

Priority

1. Applicant is advised of possible benefits under 35 U.S.C. 119(a)-(d), wherein an application for patent filed in the United States may be entitled to the benefit of the filing date of a prior application filed in a foreign country.

Claim Objections

2. Claims 3, 4, 13, and 60 are objected to because of the following informalities: either the degree symbol " ° " or the phrase "degrees" should be deleted to avoid repetition.

3. Claim 14 is objected to because of the following informalities: "1 minutes" apparently should be -- 1 minute --.

4. Claim 31 is objected to because of the following informalities: "of the is" apparently should be -- of the deformable element is --.

5. Claim 31 is objected to because of the following informalities: claim 31 apparently should be dependent upon claim 32, otherwise "the assembly" would lack the proper antecedent basis.

6. Claims 52 and 93 are objected to because of the following informalities: the claims are apparently missing periods.

7. Claim 67 is objected to because of the following informalities: "hinge" apparently should be -- the hinge --.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 1, 2, 5, 9, 10, 17-20, and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by True et al. (U.S. Patent Appl. Pub. No. 2001/0040675), as evidenced by Wolf et al., *Silicon Processing for the VLSI Era*, Vol. 1, Lattice Press (1986).

10. As to claim 1, True discloses a method for processing a deformable element (20) of a microstructure (paragraph 0020), comprising: oxidizing the deformable element (20) in an oxygen-containing gas other than air ("dry oxygen plasma") (paragraph 0026). Deformable element (or hinge) (20) is disclosed as a polysilicon material (paragraph 0020). When the sacrificial material (14) is removed by a dry plasma oxygen step (paragraph 0026), the deformable element (20) is inherently oxidized. *See* Wolf, pages 218-219.

11. Although True does not expressly disclose deflecting the deformable element (20), this step is also inherently present. Deformable element (20/50) is connected to mirror (54) (paragraph 0025; Figure 5A), which is supported by the sacrificial layer. Thus, after the sacrificial layer (14) is removed by the dry plasma oxygen step (paragraph 0026), hinge (20/50) undergoes a slight degree of bending (or deflecting) due to the force of gravity from the weight of the released mirror (50).

12. As to claim 2, True discloses that the deflected deformable element (20) is a hinge (paragraph 0020) of a micromirror device (22) (paragraph 0022) that further comprises a mirror plate attached to the hinge on a substrate (10) of the micromirror device (22) (Figure 1D).

13. As to claim 5, True discloses that the gas comprises more oxygen than is generally present in air (paragraph 0026). *See also* Wolf, page 564.

14. As to claim 9, True does not expressly disclose that the oxygen-containing gas comprises oxygen mixed with H_2O. However, H_2O is inherently a by-product of etching an organic material. *See* Wolf, page 564.

15. As to claim 10, True discloses that the oxygen-containing gas is oxygen plasma (paragraph 0026).

16. As to claim 17, True discloses that the element comprises a material that is an elemental metal, metalloid or metallic compound (paragraph 0022).

17. As to claim 18, True discloses that the element comprises a material that is a ceramic (silicon nitride, silicon oxide, silicon carbide) (paragraph 0020).

18. As to claim 19, True discloses that the element comprises a material that is polycrystalline (polysilicon) (paragraph 0020).

19. As to claim 20, True discloses that the element comprises a material that is amorphous (silicon oxide) (paragraph 0020).

20. As to claim 26, True discloses that mirror plate comprises: a metallic reflective layer (22) (paragraph 0021); and a light transmissive protecting layer for protecting

oxidization of the mirror plate (22) during operation ("[a]n optional metal passivation layer...can be added") (paragraph 0021).

Claim Rejections - 35 USC § 103

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

22. Claims 21, 27, 29-31, 33, 34, 38, 39, 42, 43, 46-49, 52, 54, 56, 57, 60-66, 69, 72, 74, 76, 77, 80-85, 88-93, 95, 97, 98, 101-106, 108, 110, 111, and 114-116 are rejected under 35 U.S.C. 103(a) as being unpatentable over True et al. (U.S. Patent Appl. Pub. No. 2001/0040675), in view of Wolf.

23. As to claim 21, True does not expressly disclose that element comprises a material that is nanocrystalline. However, True discloses that the material is polysilicon (paragraph 0020). Wolf teaches that polysilicon is commonly deposited such that the grain size is on the scale of nanometers (or nanocrystalline) (pages 179-180; Figure 15). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a material that is nanocrystalline, because Wolf teaches that nanocrystalline materials are commonly deposited.

24. As to claim 27, True discloses a method of processing a deflectable element of a microelectromechanical device (paragraph 0004).

25. True does not expressly disclose oxidizing an amount of a material of the deflectable element equivalent to at least 20 percent of the volume of the deflectable element by exposing the deflectable element in an oxygen-containing gas other than air. However, True discloses that the flexibility of the deflectable element or hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of a material of the deflectable element equivalent to at least 20 percent of the volume of the deflectable element by exposing the deflectable element in an oxygen-containing gas other than air. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

26. As to claim 29, Wolf discloses that silicon oxidizes in air at room temperature (page 200). Wolf also discloses that silicon oxidizes at 700 °C (page 201). Thus, silicon would be expected to oxidize at a temperature of from 300°C to 500°C.

27. As to claim 30, True does not expressly disclose oxidizing an amount of the material of the deformable element equivalent to at least 60 percent of the volume of the deformable element. However, True discloses that the flexibility of the deformable element or hinge (20) can be adjusted by either selecting a specific hinge material (such

as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of the material of the deformable element equivalent to at least 60 percent of the volume of the deformable element. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

28. As to claim 31, True does not expressly disclose oxidizing the deformable element such that the plastic deformation of the deformable element is reduced by at least 20 percent after a time period of from 2 minutes to 10,000 hours. However, True discloses that the flexibility of the deflectable element or hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the deformable element such that the plastic deformation of the deformable element is reduced by at least 20 percent after a time period of from 2 minutes to 10,000 hours. One who is skilled in the art would be

motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

29. As to claim 33, Wolf discloses that wafers are commonly oxidized by loading the wafers into a chamber and introducing an oxygen-containing gas into an oxidizing system (or chamber) (pages 230-232), which inherently has a first pressure. Wolf also teaches that higher gas pressures can increase the oxide growth rate (pages 216-217). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include: a) loading the assembly into a chamber; b) introducing a first component of the oxygen-containing gas with a first pressure into the chamber, because Wolf teaches that these step are commonly used for wafer oxidation. Moreover, it would have been obvious to one of ordinary skill in the art at the time the invention was made to introduce a second component of the oxygen-containing gas with a second pressure higher than the first pressure into the chamber. One who is skilled in the art would be motivated to increase the oxide growth rate by increasing pressure.

30. As to claim 34, Wolf does not expressly disclose pumping out the chamber such that the pressure inside the chamber is lower than the first pressure; and repeating the steps b) and c). True discloses that the flexibility of the deformable element or hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to pump out the chamber such that the pressure

inside the chamber is lower than the first pressure; and repeating the steps b) and c). One who is skilled in the art would be motivated to repeat the oxidation process until the appropriate flexibility of the deformable element is achieved.

31. Moreover, case law has held that the splitting of one step into two, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). The steps of pumping out the chamber such that the pressure inside the chamber is lower than the first pressure; and repeating the steps b) and c) is the splitting of one step into two.

32. As to claim 36, Wolf discloses that the oxygen-containing gas comprises air mixed with H_2O (pages 200-201).

33. As to claim 38, Wolf discloses that the oxygen-containing gas comprises oxygen mixed with H_2O (page 201).

34. As to claim 39, Wolf discloses that oxygen-containing gas is oxygen plasma (pages 218-219).

35. As to claim 42, True discloses that the deformable element comprises a material that is an elemental metal, metalloid, ceramic or metallic compound (paragraphs 0020, 0022).

36. As to claim 43, True discloses that the deformable element comprises a material that is selected from a group comprising: polycrystalline (polysilicon) and amorphous (silicon oxide) (paragraph 0020).

37. As to claim 46, True discloses a method of making a micromirror device (paragraph 0004), comprising: providing a substrate (10) (paragraph 0017; Figure 1A); forming a mirror plate (22) and hinge (20) on a sacrificial material (14) on the substrate such that the mirror plate (22) is attached to the substrate (10) via the hinge (20) (paragraph 0022; Figure 1D); removing the sacrificial material (14) using a vapor phase etchant (paragraph 0026).

38. True does not expressly disclose oxidizing the hinge in an oxygen-containing gas other than air. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the hinge in an oxygen-containing gas other than air. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

39. As to claim 47, True discloses that the vapor phase etchant comprises an interhalogen (ClF_3 or BrF_3) (paragraph 0026).

40. As to claim 48, True discloses that the vapor phase etchant comprises a noble gas halide (xenon difluoride) (paragraph 0039).

41. As to claim 49, True discloses that the noble gas halide is xenon difluoride (paragraph 0039).

42. As to claim 52, Wolf discloses that the gas comprises more oxygen than is generally presented in air (page 201).

43. As to claim 54, Wolf discloses that the oxygen-containing gas comprises air mixed with H_2O (pages 200-201).

44. As to claim 56, Wolf discloses that the oxygen-containing gas comprises oxygen mixed with H_2O (page 201).

45. As to claim 57, Wolf discloses that oxygen-containing gas is oxygen plasma (pages 218-219).

46. As to claim 60, Wolf discloses that silicon oxidizes in air at room temperature (page 200). Wolf also discloses that silicon oxidizes at 700°C (page 201). Thus, silicon would be expected to oxidize at a temperature of from 300°C to 500°C.

47. As to claim 61, True discloses that the hinge comprises a material that is an elemental metal, metalloid or metallic compound (paragraph 0022).

48. As to claim 62, True discloses that the hinge comprises a material that is ceramic (silicon nitride, silicon oxide, silicon carbide) (paragraph 0020).

49. As to claim 63, True discloses that the hinge comprises a material that is polycrystalline (polysilicon) (paragraph 0020).

50. As to claim 64, True discloses that the hinge comprises a material that is amorphous (silicon oxide) (paragraph 0020).

51. As to claim 65, True does not expressly disclose oxidizing an amount of a material of the hinge equivalent to 20% or more in volume of the hinge. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of a material of the hinge equivalent to 20% or more in volume of the hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

52. As to claim 66, True does not expressly disclose oxidizing an amount of a material of the hinge equivalent to 50% or more in volume of the hinge. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be

accurately predicted (page 209). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of a material of the hinge equivalent to 50% or more in volume of the hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

53. As to claim 69, True discloses a method of making a micromirror device (paragraph 0004), comprising: providing a substrate (10) (paragraph 0017; Figure 1A); forming a mirror plate (22) and hinge (20) on a sacrificial material (14) on the substrate such that the mirror plate is attached (22) to the substrate (10) via hinge (20) (paragraph 0022; Figure 1D); removing a portion of the sacrificial material (14) using a vapor phase etchant such that at least a portion of the hinge is exposed (paragraphs 0026, 0039); and removing the remaining sacrificial material (14) (paragraphs 0026, 0039).

54. True does not expressly disclose oxidizing the exposed hinge in an oxygen-containing gas other than air. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the hinge in an oxygen-containing gas other than air. One who is skilled in the art would be motivated

to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

55. As to claim 72, Wolf discloses that the gas comprises more oxygen than is generally presented in air (page 201).

56. As to claim 74, Wolf discloses that the oxygen-containing gas comprises air mixed with H_2O (pages 200-201).

57. As to claim 76, Wolf discloses that the oxygen-containing gas comprises oxygen mixed with H_2O (page 201).

58. As to claim 77, Wolf discloses that oxygen-containing gas is oxygen plasma (pages 218-219).

59. As to claim 80, Wolf discloses that the oxidization is performed at a temperature of from 300°C or more (700°C to 1300°C) (page 201).

60. As to claim 81, True discloses that the hinge comprises a material that is an elemental metal, metalloid or metallic compound (paragraph 0022).

61. As to claim 82, True discloses that the hinge comprises a material of SiN_x (silicon nitride) (paragraph 0020).

62. As to claim 83, True discloses that the hinge comprises a material that is polycrystalline (polysilicon) (paragraph 0020).

63. As to claim 84, True discloses that the hinge comprises a material that is amorphous (silicon oxide) (paragraph 0020).

64. As to claim 85, True does not expressly disclose oxidizing an amount of a material of the hinge equivalent to 70% or more in volume of the hinge. However, True

discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of a material of the hinge equivalent to 70% or more in volume of the hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

65. As to claim 88, True discloses that the gas etchant comprises XeF_2 (paragraph 0039).

66. As to claim 89, True discloses a method of making a micromirror device (paragraph 0004), comprising: providing a substrate (10) (paragraph 0017; Figure 1A); depositing a hinge layer (20) (paragraph 0020) and a mirror plate layer (22) (paragraph 0021) on a sacrificial material (14) (paragraph 0018) on the substrate (10) (paragraph 0010) (Figures 1A-1D); patterning the hinge layer (20) (paragraph 0023); and removing the sacrificial layer (14) (paragraph 0026).

67. True does not expressly disclose oxidizing the hinge layer to form an oxidized hinge. However, True discloses that the flexibility of the hinge (20) can be adjusted by

either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the hinge layer to form an oxidized hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

68. As to claim 90, True does not expressly disclose that the step of patterning is performed before oxidizing the hinge layer, as in the modified teachings. However, case law has held that the transposition of two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to pattern before oxidizing the hinge layer, as in the modified teachings.

69. As to claim 91, True does not expressly disclose that the step of patterning is performed after oxidizing the hinge layer, as in the modified teachings. However, case law has held that the transposition of two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP §

2144.04 (IV)(C). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to pattern after oxidizing the hinge layer, as in the modified teachings.

70. As to claim 92, Wolf discloses oxidizing with an oxygen-containing gas (page 201).

71. As to claim 93, Wolf discloses that the gas comprises more oxygen than is generally presented in air (page 201).

72. As to claim 95, Wolf discloses that the oxygen-containing gas comprises air mixed with H_2O (pages 200-201).

73. As to claim 97, Wolf discloses that the oxygen-containing gas comprises oxygen mixed with H_2O (page 201).

74. As to claim 98, Wolf discloses that the oxygen-containing gas is an oxygen plasma (pages 218-219). Wolf further discloses that downstream configuration is advantageous because radiation damage is minimized (page 570).

75. As to claim 101, True discloses that the hinge comprises a material that is an elemental metal, metalloid or metallic compound (paragraph 0022).

76. As to claim 102, True discloses that the hinge comprises a material that is ceramic (silicon nitride, silicon oxide, silicon carbide) (paragraph 0020).

77. As to claim 103, True discloses that the hinge comprises a material that is polycrystalline (polysilicon) (paragraph 0020).

78. As to claim 104, True discloses that the hinge comprises a material that is amorphous (silicon oxide) (paragraph 0020).

79. As to claim 105, True does not expressly disclose oxidizing an amount of a material of the hinge equivalent to 20% or more in volume of the hinge. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of a material of the hinge equivalent to 20% or more in volume of the hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

80. As to claim 106, True discloses a method of making a micromirror device (paragraph 0004), comprising: providing a substrate (10) (paragraph 0017; Figure 1A); forming a mirror plate (22) and hinge (20) on a sacrificial layer (14) on the substrate such that the mirror plate (22) is attached to the substrate (10) via the hinge (20) (paragraph 0022); and removing the sacrificial layer (14) (paragraphs 0026, 0039).

81. True does not expressly disclose cleaning and oxidizing the micromirror device, further comprising: providing a gas that is an oxygen-containing gas other than air, the oxygen-containing gas cleaning the micromirror and oxidizing an amount of the material

of the hinge equivalent to at least 25% in volume of the hinge. True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize an amount of the material of the hinge equivalent to at least 25% in volume of the hinge. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process. Moreover, the exposure of the micromirror to an oxygen-containing gas other than air would inherently clean the micromirror. *See* Wolf, page 564.

82. As to claim 108, Wolf discloses that silicon oxidizes in air at room temperature (page 200). Wolf also discloses that silicon oxidizes in water vapor (page 201). Thus, silicon would be expected to oxidize in the oxygen-containing gas comprising air mixed with H_2O.

83. As to claim 110, Wolf discloses that the oxygen-containing gas comprises oxygen mixed with H_2O (page 201).

84. As to claim 111, Wolf discloses that oxygen-containing gas is oxygen plasma (pages 218-219).

85. As to claim 114, True discloses that the deformable element comprises a material that is an elemental metal, metalloid or metallic compound (paragraphs 0020, 0022).

86. As to claim 115, True discloses that the hinge comprises a material that comprises aluminum (paragraph 0021). True also teaches that material could be a transition metal alloy (paragraph 0022), but does not expressly disclose titanium. Wolf teaches that titanium-aluminum alloys are important and commonly used during silicon device fabrication (page 374). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention as made to use a material that comprises titanium and aluminum, because Wolf teaches that such alloys are important and commonly used during silicon device fabrication.

87. As to claim 116, True discloses that the hinge comprises a material that is polycrystalline (polysilicon) (paragraph 0020).

Claim Rejections - 35 USC § 103

88. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over True, in view of Shinagawa et al. (U.S. Patent No. 5,057,187).

89. As to claim 13, True does not expressly disclose that the oxidization is performed at a temperature of from 100°C to 500°C. However, Shinagawa teaches that a typical oxygen plasma temperature ranges from 200°C to 300°C (column 2, lines 12-24). It should be noted that there is overlap between Shinagawa's range and the range claimed by the Applicants. Therefore, it would have been obvious to one of ordinary

skill in the art at the time the invention was made to oxidize at a temperature of from 100°C to 500°C. One who is skilled in the art would be motivated to select a temperature range that overlaps with a conventional temperature range for an oxygen plasma.

90. As to claim 14, True does not expressly disclose that exposing the deformable element in the oxygen-containing gas for 1 minute to 500 hours or more. However, Shinagawa teaches that a typical removal rate for organic material is about 0.5 μm/minute (column 2, lines 12-24). Thus, the total exposure time would be on the order of minutes, which is within the range claimed by the Applicants. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to expose the deformable element in the oxygen-containing gas for 1 minute to 500 hours or more. One who is skilled in the art would be motivated to expose the organic material for the typical time required for removal.

Claim Rejections - 35 USC § 103

91. Claims 50 and 70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doan et al. (U.S. Patent No. 6,804,039), in view of True, in further view of Wolf.

92. The applied Doan reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an

invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(l)(1) and § 706.02(l)(2).

93. As to claim 50, Doan discloses a method of making a micromirror device (column 1, lines 52-56), comprising: providing a substrate (230) (column 8, line 48; Figure 5A); forming a mirror plate (110) (column 8, lines 49-50) and hinge (350/370) (column 10, lines 16-18) on a sacrificial material (100/330) (column 8, lines 56-61; column 9, lines 37-44) on the substrate (230) such that the mirror plate (110) is attached to the substrate (230) via the hinge (350/370) (Figure 5A); and removing the sacrificial material (100/330) using a vapor phase etchant (column 14, lines 5-34). Doan further discloses that the step of forming the mirror plate and hinge further comprises: depositing a first sacrificial layer (100) on the substrate (230) (column 8, lines 56-62); forming a mirror plate (110) on the first sacrificial layer (100) (column 9, lines 7-9); depositing a second sacrificial layer (330) (column 9, lines 37-44); and forming a hinge on (350/370) the second sacrificial layer (330) (column 10, lines 16-18).

94. Doan does not expressly disclose oxidizing the hinge in an oxygen-containing gas other than air. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the hinge in an oxygen-containing gas other than air. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

95. As to claim 70, Doan discloses a method of making a micromirror device (column 1, lines 52-56), comprising: providing a substrate (230) (column 8, line 48; Figure 5A); forming a mirror plate (110) (column 8, lines 49-50) and hinge (350/370) (column 10, lines 16-18) on a sacrificial material (100/330) (column 8, lines 56-61; column 9, lines 37-44) on the substrate (230) such that the mirror plate (110) is attached to the substrate (230) via hinge (350/370) (Figure 5A); and removing a portion of the sacrificial material (100/330) using a vapor phase etchant (column 14, lines 5-34) such that at least a portion of the hinge is exposed (Figure 5C); and removing the remaining sacrificial material (column 14, lines 5-34). Doan further discloses that the step of forming the mirror plate and hinge further comprises: depositing a first sacrificial layer (100) on the substrate (230) (column 8, lines 56-62); forming a mirror plate (110) on the

first sacrificial layer (100) (column 9, lines 7-9); depositing a second sacrificial layer (330) (column 9, lines 37-44); and forming a hinge on (350/370) the second sacrificial layer (330) (column 10, lines 16-18).

96. Doan does not expressly disclose oxidizing the hinge in an oxygen-containing gas other than air. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). Wolf teaches that the oxidation of silicon is a well understood process with oxygen gas (pages 200-201) and that thin oxides can be grown in a controlled manner (pages 209-210). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the hinge in an oxygen-containing gas other than air. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

Claim Rejections - 35 USC § 103

97. Claims 35, 37, 40, 53, 55, 58, 73, 75, 78, 94, 96, 99, 107, 109, and 112 are rejected under 35 U.S.C. 103(a) as being unpatentable over True, in view of Wolf, in further view of Yu et al. (U.S. Patent No. 6,180,543).

98. As to claims 35, 53, 73, 94, and 107, Wolf does not expressly disclose that the oxygen-containing gas comprises ozone. However, Yu discloses that a common oxidizing atmosphere contains additional compounds including ozone or hydrogen

peroxide (column 3, lines 41-49, lines 60-63). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an oxygen-containing gas comprising ozone, as taught by Yu. One who is skilled in the art would be motivated to use a commonly used oxidizing atmosphere, known to oxidize silicon.

99. As to claims 37, 55, 75, 96, and 109, Wolf discloses that the oxygen containing gas comprises H_2O (page 201). Wolf does not expressly disclose that the oxygen-containing gas comprises ozone. However, Yu discloses that a common oxidizing atmosphere contains additional compounds including ozone or hydrogen peroxide (column 3, lines 41-49, lines 60-63). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an oxygen-containing gas comprising ozone mixed with H_2O. One who is skilled in the art would be motivated to use a commonly used oxidizing atmosphere, known to oxidize silicon.

100. As to claims 40, 58, 78, 99, and 112, Wolf does not expressly disclose that the oxygen-containing gas comprises hydrogen peroxide. However, Yu discloses that a common oxidizing atmosphere contains additional compounds including ozone or hydrogen peroxide (column 3, lines 41-49, lines 60-63). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an oxygen-containing gas comprising hydrogen peroxide, as taught by Yu. One who is skilled in the art would be motivated to use a commonly used oxidizing atmosphere, known to oxidize silicon.

Claim Rejections - 35 USC § 103

101. Claims 44, 45, 67, 68, 86, and 87 are rejected under 35 U.S.C. 103(a) as being unpatentable over True et al. (U.S. Patent Appl. Pub. No. 2001/0040675), in view of Wolf, in further view of Callister, *Materials Science and Engineering*, 4th ed., John Wiley & Sons (1997).

102. As to claims 44 and 67, True does not expressly disclose oxidizing the element such that the electrical resistance of hinge after oxidization is two times or more of the electrical resistance before oxidization. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Moreover, Callister teaches that electrical resistivity is directly related to the dimensions of the geometry of the structure (page 592), including a structure containing two different materials (page 601). In other words, there is a suggestion that resistivity can be used to measure the oxide thickness. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the element such that the electrical resistance of the hinge after oxidization is two times or more of the electrical resistance before oxidization. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

103. As to claims 45 and 68, True doe not expressly disclose oxidizing the element such that the electrical resistance of hinge after oxidization is four times or more of the electrical resistance before oxidization. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Moreover, Callister teaches that electrical resistivity is directly related to the dimensions of the geometry of the structure (page 592), including a structure containing two different materials (page 601). In other words, there is a suggestion that resistivity can be used to measure the oxide thickness. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the element such that the electrical resistance of the hinge after oxidization is four times or more of the electrical resistance before oxidization. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

104. As to claim 86, True doe not expressly disclose oxidizing the element such that the electrical resistance of hinge after oxidization is six times or more of the electrical resistance before oxidization. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride,

silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total thickness or volume of the oxide can be accurately predicted (page 209). Moreover, Callister teaches that electrical resistivity is directly related to the dimensions of the geometry of the structure (page 592), including a structure containing two different materials (page 601). In other words, there is a suggestion that resistivity can be used to measure the oxide thickness. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the element such that the electrical resistance of the hinge after oxidization is six times or more of the electrical resistance before oxidization. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

105. As to claim 87, True doe not expressly disclose oxidizing the element such that the electrical resistance of hinge after oxidization is eight times or more of the electrical resistance before oxidization. However, True discloses that the flexibility of the hinge (20) can be adjusted by either selecting a specific hinge material (such as silicon nitride, silicon oxide, silicon carbide, polysilicon) or controlling the thickness of the hinge (paragraph 0020). True further teaches that the thickness of the hinge (20) ranges from 20 Å to 2100 Å, which is over a forty-fold increase in thickness (paragraph 0020). Wolf also teaches that oxidation of silicon is a well understood process and the total

thickness or volume of the oxide can be accurately predicted (page 209). Moreover, Callister teaches that electrical resistivity is directly related to the dimensions of the geometry of the structure (page 592), including a structure containing two different materials (page 601). In other words, there is a suggestion that resistivity can be used to measure the oxide thickness. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to oxidize the element such that the electrical resistance of the hinge after oxidization is eight times or more of the electrical resistance before oxidization. One who is skilled in the art would be motivated to control the flexibility of the hinge by controlling the thickness of the hinge and selecting an oxide material, which can be produced by a well understood process.

Allowable Subject Matter

106. Claims 3, 4, 6-8, 11, 12, 15, 16, 22-25, 28, 32, 41, 51, 59, 71, 79, 100, and 113 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

107. The following is a statement of reasons for the indication of allowable subject matter for claim 3: the prior art fails to teach or suggest deflecting the deformable element further comprises: deflecting the deformable element to an ON state that corresponds to a state wherein the mirror plate is rotated to an ON state angle of from 10° to 18° degrees in a first rotation direction relative to the substrate. In the closet prior art, True, after the sacrificial layer (14) is removed by the dry plasma oxygen step

(paragraph 0026), hinge (20/50) inherently undergoes a slight degree of bending (or deflecting) due to the force of gravity from the weight of the released mirror (50). However, there is no motivation or suggestion of deflecting the deformable element from 10° to 18° degrees in a first rotation direction relative to the substrate.

108. The following is a statement of reasons for the indication of allowable subject matter for claim 4: the prior art fails to teach or suggest deflecting the deformable element further comprising: deflecting the deformable element to an OFF state that corresponds to a state wherein the mirror plate is rotated to an OFF state angle of from -0.1° to -8° degrees relative to the substrate, as discussed above.

109. The following is a statement of reasons for the indication of allowable subject matter for claim 6: the prior art fails to teach or suggest that the oxygen-containing gas comprises ozone. The closest prior art, True, discloses dry plasma oxygen (paragraph 0026). Wolf teaches that a dry plasma oxygen is a pure oxygen plasma (page 654). However, there is no motivation or suggestion that oxygen-containing gas comprises ozone.

110. The following is a statement of reasons for the indication of allowable subject matter for claim 7: the prior art fails to teach or suggest that the oxygen-containing gas comprises air mixed with H_2O, as discussed above.

111. The following is a statement of reasons for the indication of allowable subject matter for claim 8: the prior art fails to teach or suggest that the oxygen-containing gas comprises ozone mixed with H_2O, as discussed above.

112. The following is a statement of reasons for the indication of allowable subject matter for claim 11: the prior art fails to teach or suggest that the oxygen-containing gas comprises hydrogen peroxide, as discussed above.

113. The following is a statement of reasons for the indication of allowable subject matter for claim 12: the prior art fails to teach or suggest that the oxygen-containing gas comprises acetic acid, as discussed above.

114. The following is a statement of reasons for the indication of allowable subject matter for claim 15: the prior art fails to teach or suggest exposing the deformable element in the oxygen-containing gas for 50 hours or more. The closest prior art, True, discloses dry plasma oxygen (paragraph 0026). Moreover, Shinagawa teaches that for plasma ashing, organic material is removed at a rate of about 0.5 μm/minute (column 2, lines 12-24).

115. The following is a statement of reasons for the indication of allowable subject matter for claim 16: the prior art fails to teach or suggest exposing the deformable element in the oxygen-containing gas for 100 hours or more, as discussed above.

116. The following is a statement of reasons for the indication of allowable subject matter for claim 22: the prior art fails to teach or suggest oxidizing an amount of the material equivalent to 20% or more of the volume of the deformable element. The closest prior art, True, discloses dry plasma oxygen to remove organic material (paragraph 0026).

117. The following is a statement of reasons for the indication of allowable subject matter for claim 23: the prior art fails to teach or suggest oxidizing an amount of the

material equivalent to 50% or more of the volume of the deformable element, as discussed above.

118. The following is a statement of reasons for the indication of allowable subject matter for claim 24: the prior art fails to teach or suggest oxidizing the element such that the electrical resistance of the element after oxidization is two times or more of the electrical resistance before oxidization, as discussed above.

119. The following is a statement of reasons for the indication of allowable subject matter for claim 25: the prior art fails to teach or suggest oxidizing the element such that the electrical resistance of the element after oxidization is four times or more of the electrical resistance before oxidization, as discussed above.

120. The following is a statement of reasons for the indication of allowable subject matter for claim 28: the prior art fails to teach or suggest that the oxidizing of the hinge reduces changes in a rest state of the mirror plate over time. The closest prior art, True, suggests that the flexibility of the deflectable element or hinge (20) can be adjusted by either selecting a specific hinge material or controlling the thickness of the hinge (paragraph 0020).

121. The following is a statement of reasons for the indication of allowable subject matter for claim 32: the prior art fails to teach or suggest introducing the oxygen-containing gas to the deformable element through a micro-opening of an assembly in which the deformable element is encapsulated, wherein the micro-opening has a dimension around 10 micrometers or less. Wolf teaches that silicon oxidation is commonly performed by placing wafers in an oxidation system (pages 230-232).

122. The following is a statement of reasons for the indication of allowable subject matter for claims 41, 59, 79, 100, and 113: the prior art fails to teach or suggest that the oxygen containing gas contains acetic acid. Wolf teaches that for the grown of uniform oxides, additives include halogen based impurities (page 211). However, there is no motivation or suggestion of the oxygen containing gas containing acetic acid.

123. The following is a statement of reasons for the indication of allowable subject matter for claims 51 and 71: there is no motivation or suggestion of forming a *hinge* on the *first sacrificial layer*; and forming a mirror plate on the *second sacrificial layer* (emphasis added). The closest prior art, Doan, discloses forming a *mirror plate* (110) on the *first sacrificial layer* (100) (column 9, lines 7-9); and forming a *hinge* on (350/37) the *second sacrificial layer* (330) (column 10, lines 16-18) (emphasis added). However, there is no motivation or suggestion of forming a hinge of the first sacrificial layer; and forming a mirror plate on the second sacrificial layer, as in the context of claims 51 and 71.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

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EBC EBC
Dec. 8, 2005

SHAMIM AHMED
PRIMARY EXAMINER